

# ***The Birdstrike Identification Program at The Smithsonian Institution***

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Division of Birds, National Museum of Natural History  
Washington, DC



# "BIRDSTRIKE

## IDENTIFICATION"

Each year bird-aircraft collisions (birdstrikes) cause an average of \$44 M in damages to US Air Force, and \$600 M in damages to US civil aircraft.



T-38 - White-tailed Hawk



American Airlines - Canada Goose



Experimental Aircraft - Lesser Scaup



T-38 - Great Egret



## Top USAF Birdstrikes Strikes by Cost

Current as of 1 Jan 2007

Common Name	Cost	Count	Cost per 100K Flying Hours
American White Pelican	\$257,628,460.00	18	\$444,527.78
Canada Goose	\$92,328,526.00	129	\$159,309.24
Black Vulture	\$54,355,588.00	403	\$93,788.43
Turkey Vulture	\$51,708,040.00	776	\$89,220.19
Spot-billed Duck	\$24,920,198.00	13	\$42,998.82
Red-tailed Hawk	\$13,353,102.00	781	\$23,354,.29
Barn Swallow/Swallow	\$11,272,852.00	1745	\$19,450.86
Dark-eyed Junco	\$10,043,181.00	100	\$17,329,11
American Mourning Dove	\$9,520,849.00	2497	\$16,427.85
Snow Goose	\$6,317,841.00	73	\$86,545.77
Horned Lark	\$5,760,469.00	2989	\$9,939.49

# 2007 How Much Damage Can A Bird Cause? 2007



Canada Goose. ©Dan Sudia

\$7,176/strike (\$7,176/1)



Red-tailed Hawk, note dark "patagial" mark of leading edge.  
Photo - WS Clark - U.S.G.S.

\$32,258/strike (\$1M/31)



Photography AcclaimImages.com Photography

\$547/strike



\$2,042/strike  
(\$335,000/164)

# Benefits of species identification data:

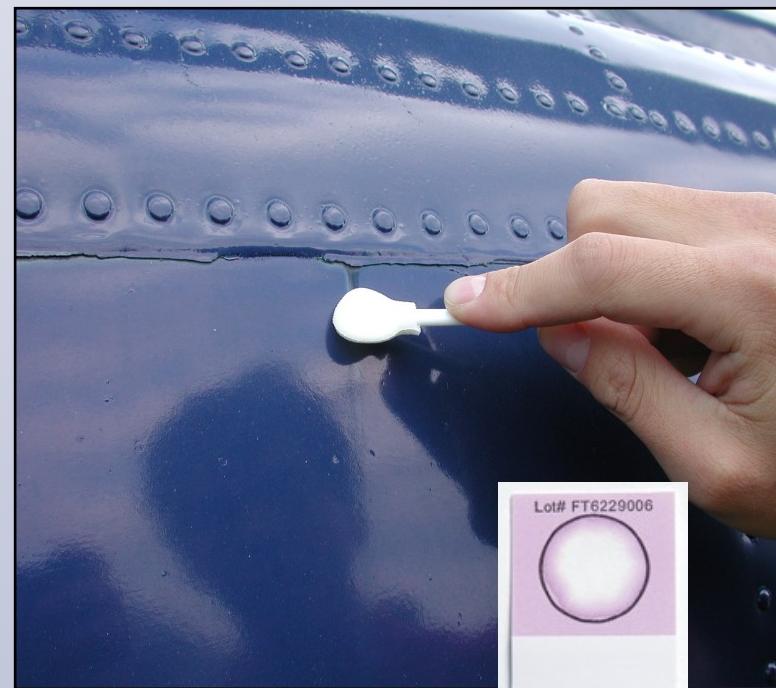
Development of protection against aircraft

windshields and engines based on weights of birds

- USAF F-16 cockpit redesigned to lower pilot's seat in position to avoid injury from break-away debris
- Data used for USAF BAM (Bird Avoidance Model)
- Data used to justify construction of landfills away from airfields
- Habitat management plans implemented to discourage bird use on airfields
- Pest Management/bird control on airfields
- USFWS depredation permits
- Information on migration, habitat preference, diet, life history







# FEATHER IDENTIFICATION - Whole Feathers

**50% OF THE  
BIRDSRIKE SAMPLES  
ARE IDENTIFIED  
USING  
CHARACTERISTICS  
OF WHOLE  
FEATHERS**

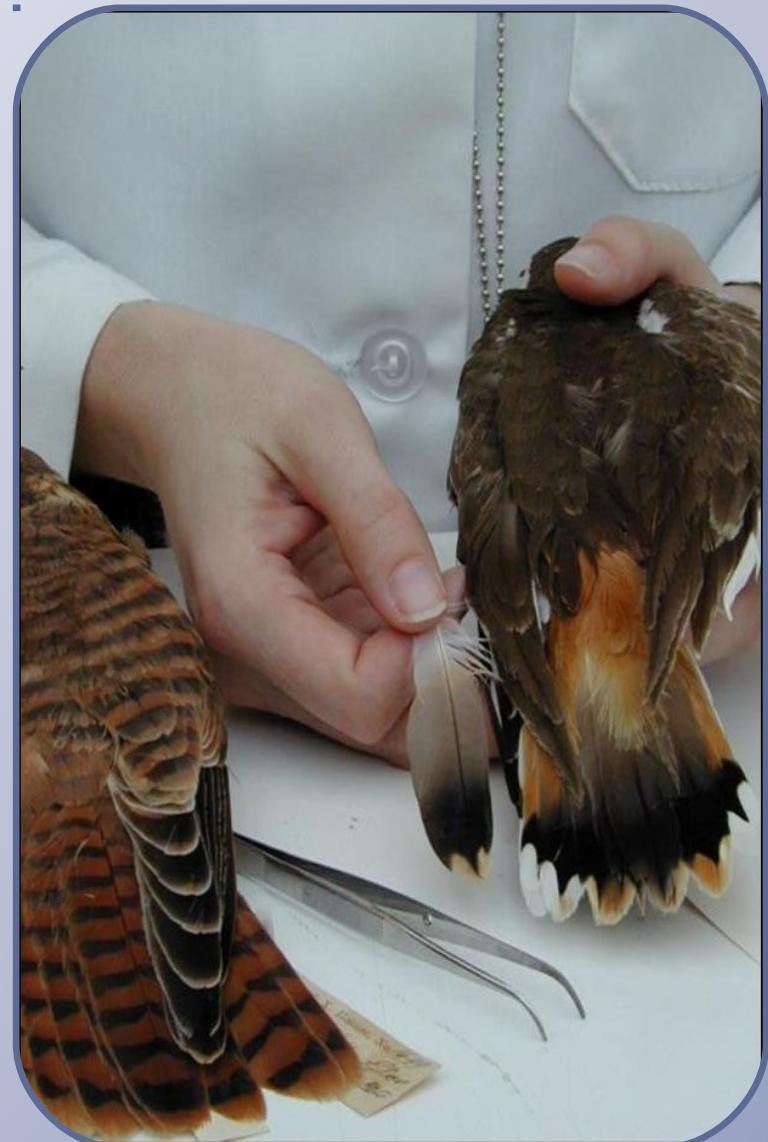
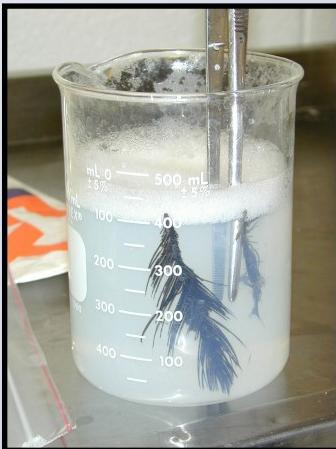
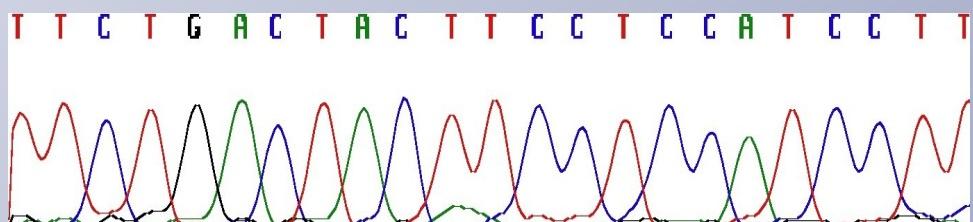


Photo: Chip Clark

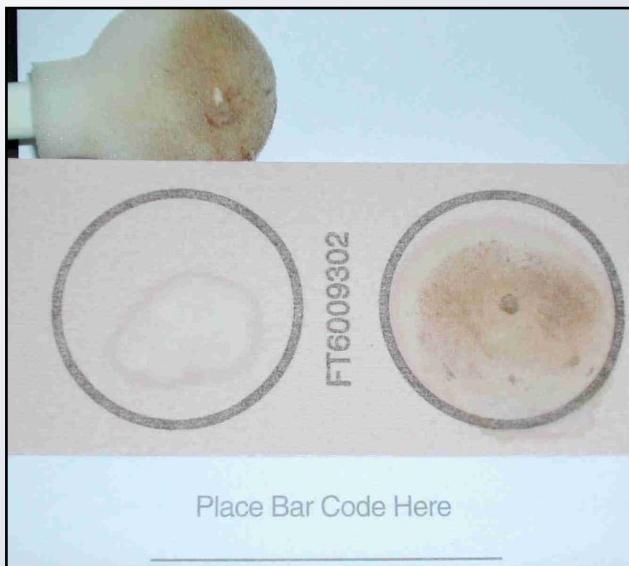




# FEATHER IDENTIFICATION -DNA Analysis







# BARCODE OF LIFE DATA SYSTEMS

Advancing species identification and discovery through the analysis of short, standardized gene regions

SEARCH

About BOLD Contact Us



[Published Projects](#) | [Identify Specimen](#) | [Request an Account](#) | [Introductory Tutorial](#) | [Documentation](#) | [Citation](#)

The Barcode of Life Data Systems (BOLD) is an online workbench that aids collection, management, analysis, and use of DNA barcodes. It consists of 3 components (MAS, IDS, and ECS) that each address the needs of various groups in the barcoding community.



## MANAGEMENT & ANALYSIS

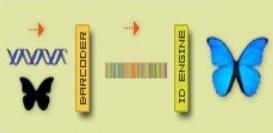
**BOLD-MAS** provides a repository for barcode records coupled with analytical tools. It serves as an online workbench for the DNA barcode community.

Username  Password



## IDENTIFICATION ENGINE

**BOLD-IDS** provides a species identification tool that accepts DNA sequences from the barcode region and returns a taxonomic assignment to the species level when possible.



## EXTERNAL CONNECTIVITY

**BOLD-ECS** provides web developers and bioinformaticians the ability to build tools and workflows that can be integrated with the BOLD framework. We welcome the addition of new analytical modules.



## BARCODING CAMPAIGNS

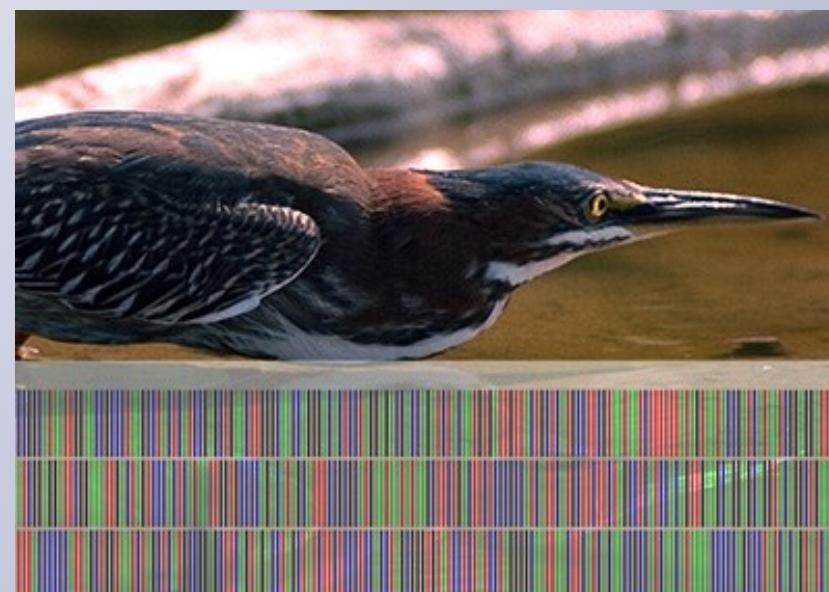
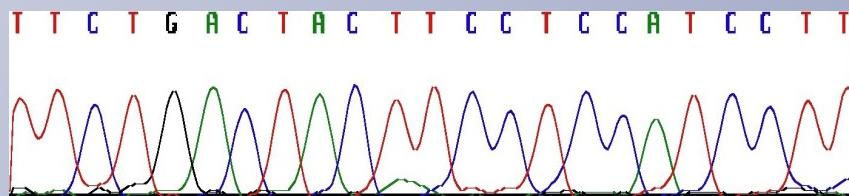


Photo courtesy Biodiversity Institute of Ontario



**A DNA “barcode” is a 648 bp portion of a gene called cytochrome c oxidase subunit 1 (CO1) that has been selected as a standardized region for species identification**



**BOLD - ID**

The BOLD Identification System (IDS) accepts sequences from the 5' region of the mitochondrial gene COI and returns a species-level identification when one is possible. Further validation with independent genetic markers will be desirable in some forensic applications.

The reference database of validated records is used by default and is recommended for all identification purposes.

**Search Database:**

- All Available Barcode Records (165,048 Sequences/19,163 Species)  
Full database of barcode records (warning: unvalidated dataset). This includes many species represented by only one or two specimens as well as all species with interim taxonomy.
- Reference Barcode Database (59,885 Sequences/6,476 Species)  
Validated subset of the full database containing only those species represented by three or more individuals showing less than 2% sequence divergence

**Enter sequences in fasta format:**

```
attggcacagcaactcagccgtctaatc  
cgcgtgaactaggccagccaggaacctcttaggtatgaccaaattataacgtaatc  
gtcaccgcccacgcctttaataatcttcatggatacccatcataattggagga  
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acattttcgatcccgctggagg|
```



## Specimen Identification Request

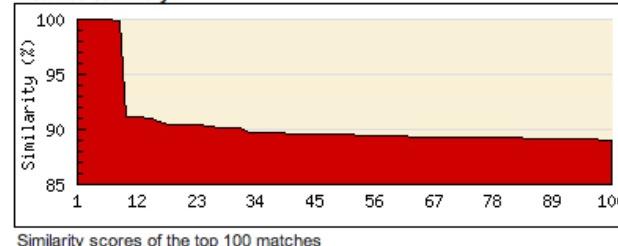
**Search Request:**

Type : Reference Database Search

**Search Result:**
**Identification Summary :**

Taxonomic Level	Taxon Assignment	Probability of Placement (%)
Phylum	Chordata	100
Class	Aves	100
Order	Anseriformes	100
Family	Anatidae	100
Genus	Aix	100
Species	Aix sponsa	100

A species level match has been made. This identification is solid unless there is a very closely allied congeneric species that has not yet been analyzed. Such cases are rare.

[Tree Based Identification](#)
[Species Page](#)
**Distance Summary :**

**TOP 20 Matches :**

Phylum	Class	Order	Family	Genus	Species	Specimen Similarity (%)	Display option: <input type="button" value="default"/>
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	100	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	99.83	
Chordata	Aves	Anseriformes	Anatidae	Aix	sponsa	99.83	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	91.16	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	91.16	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	91.16	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	91.13	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	91.07	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	90.98	
Chordata	Aves	Anseriformes	Anatidae	Melanitta	nigra	90.77	
Chordata	Aves	Anseriformes	Anatidae	Bucephala	islandica	90.58	
Chordata	Aves	Anseriformes	Anatidae	Bucephala	islandica	90.4	
Chordata	Aves	Anseriformes	Anatidae	Bucephala	islandica	90.4	
Chordata	Aves	Anseriformes	Anatidae	Bucephala	islandica	90.4	

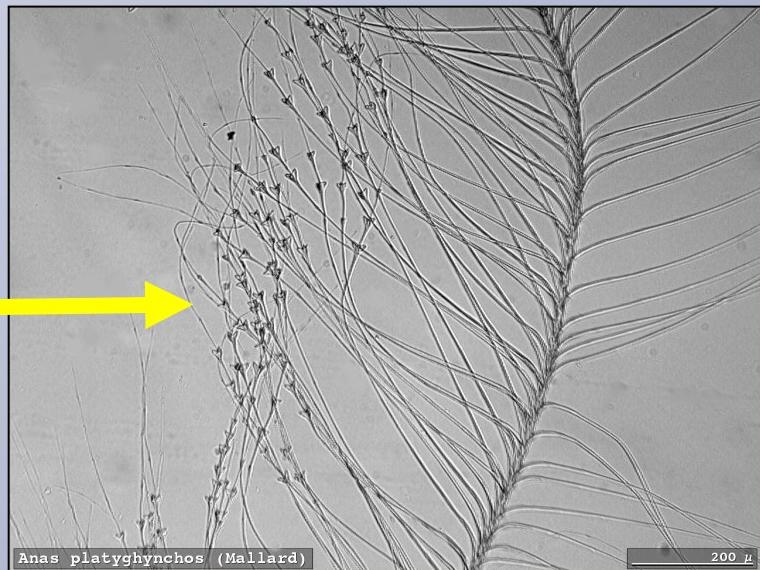
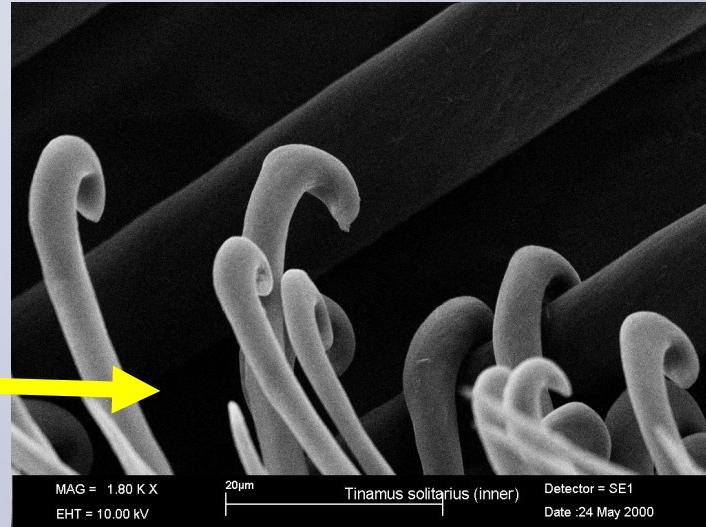
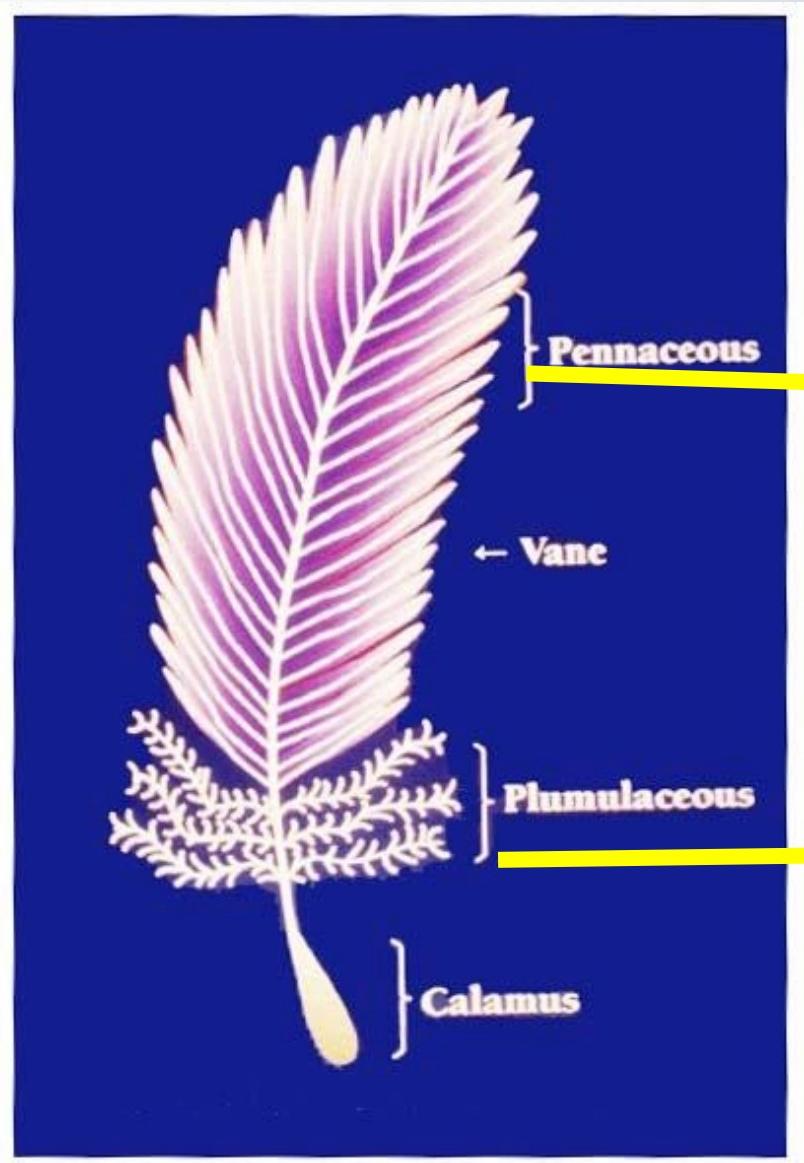
100% match  
to Wood Duck  
(*Aix sponsa*)



# FEATHER IDENTIFICATION -Microscopic Analysis



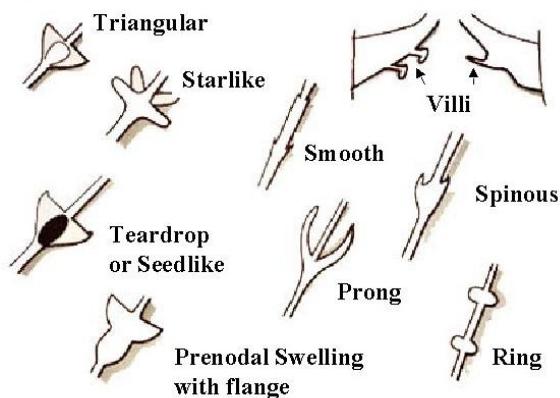
# FEATHER IDENTIFICATION -Microscopic Analysis



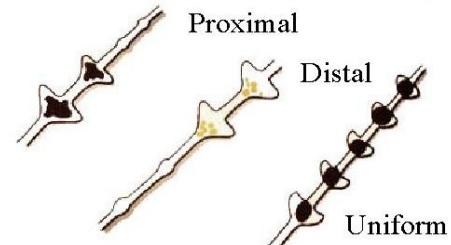
# FEATHER IDENTIFICATION -Microscopic Analysis



## Types of NODAL STRUCTURES

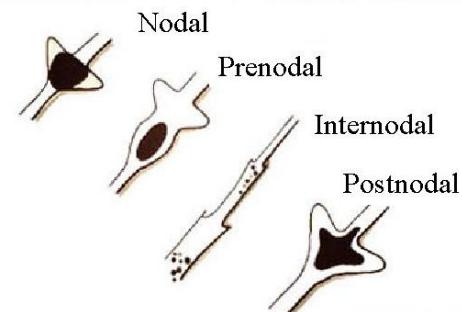


## LOCATION OF NODES

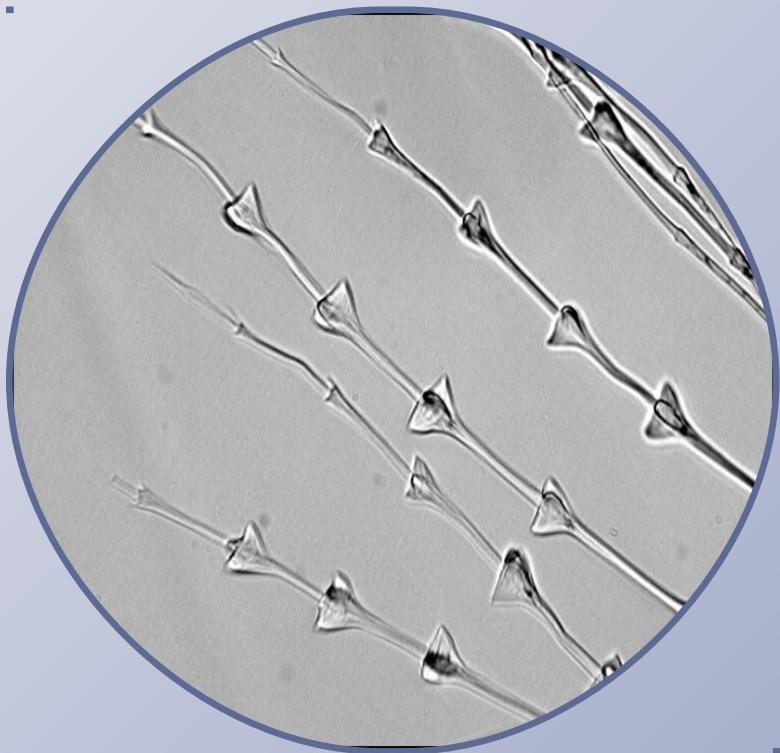
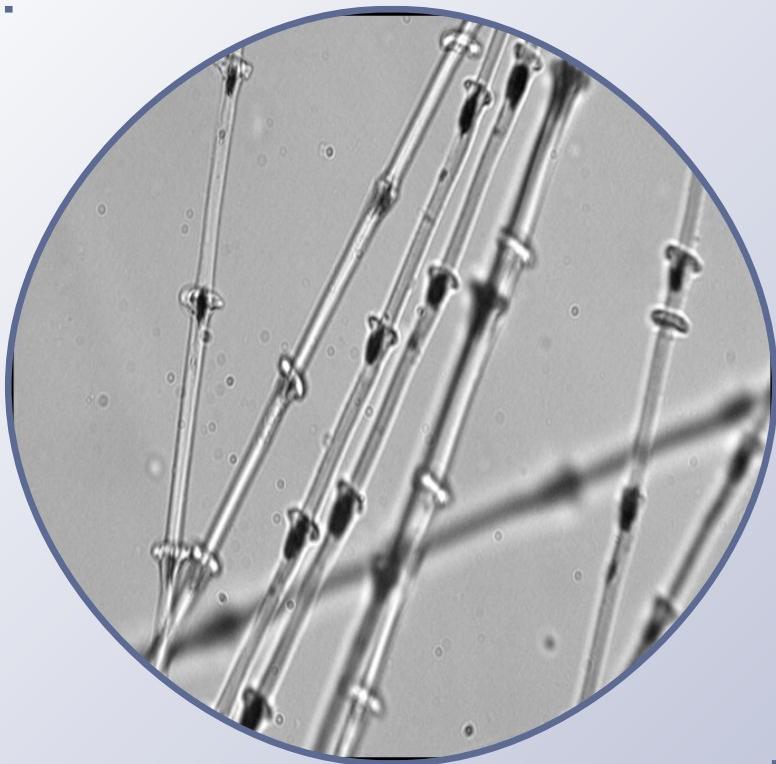


Different Types of Nodal Structures may exist on same Downy Barbs.

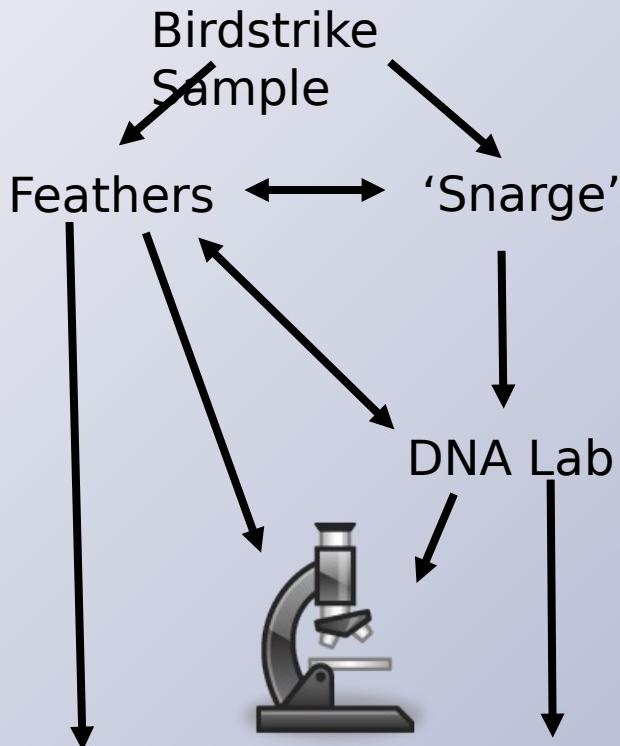
## PIGMENT DISTRIBUTION



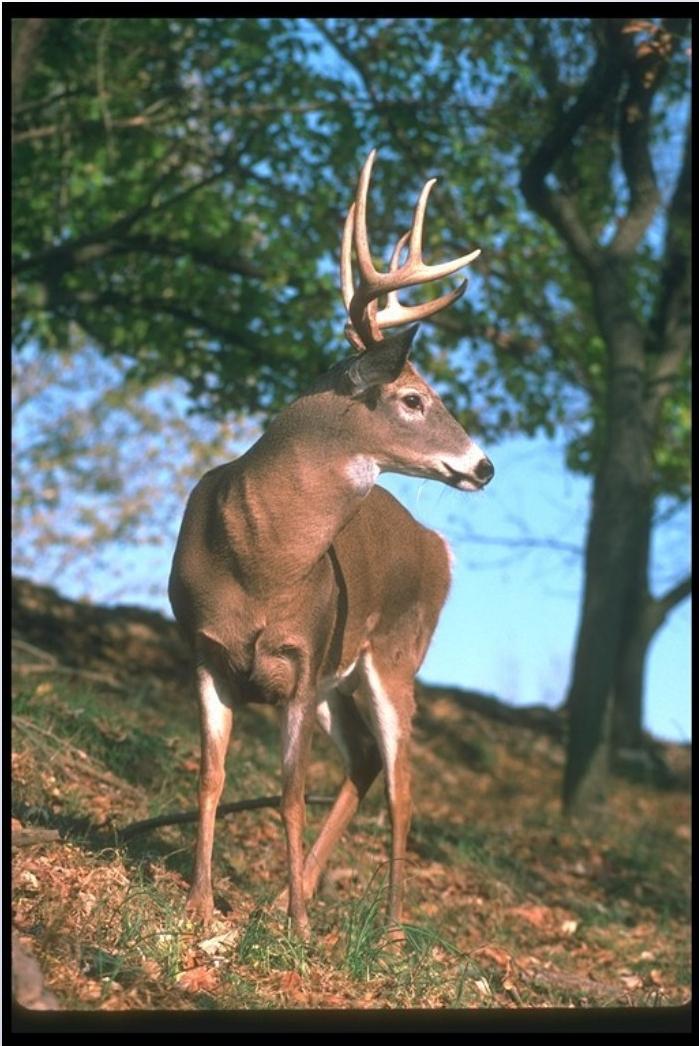
# FEATHER IDENTIFICATION -Microscopic Analysis



# FEATHER IDENTIFICATION TOOLBOX



Species Identification



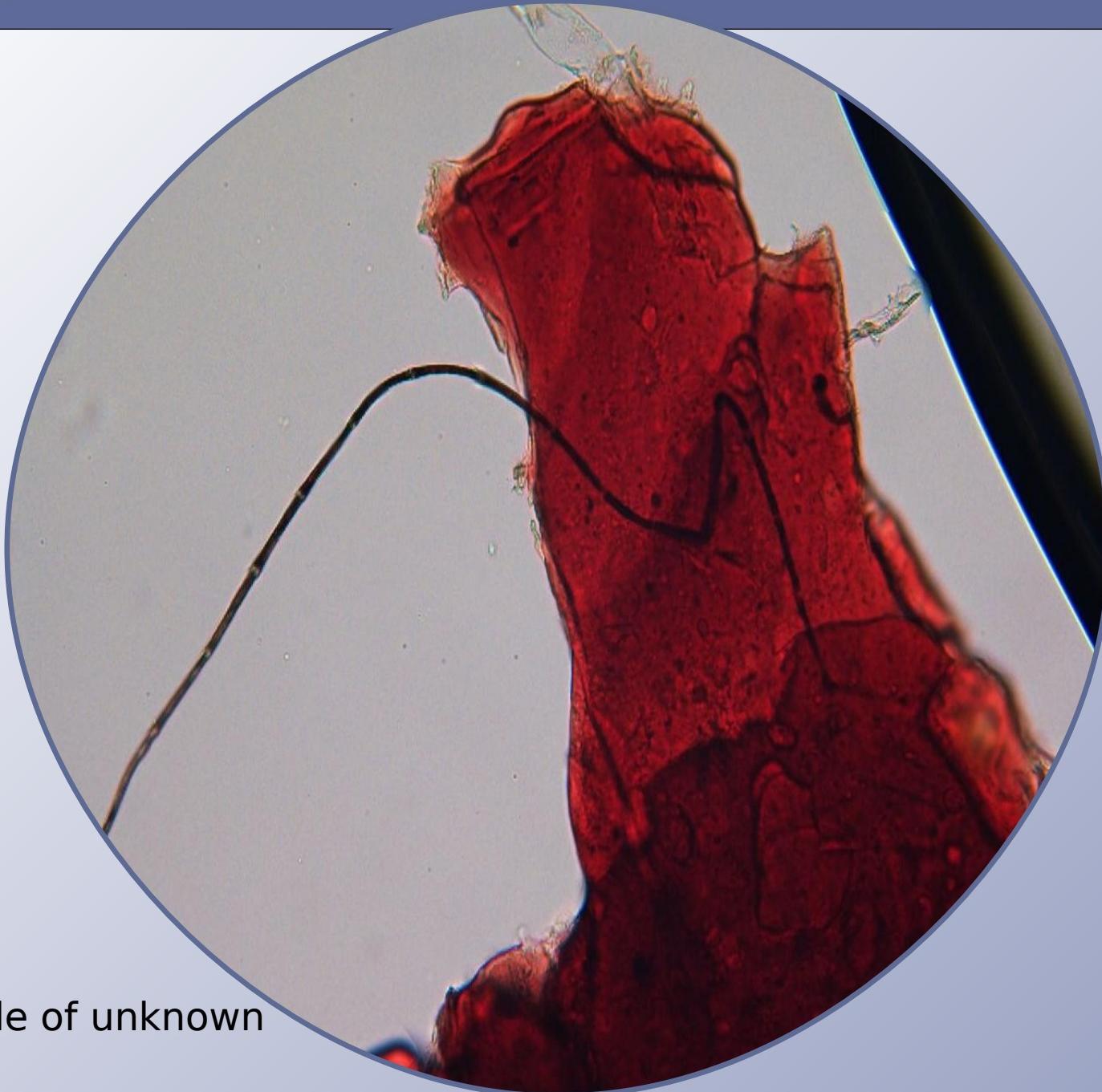
14 January 2008, Randolph AFB

Damage = \$8,000

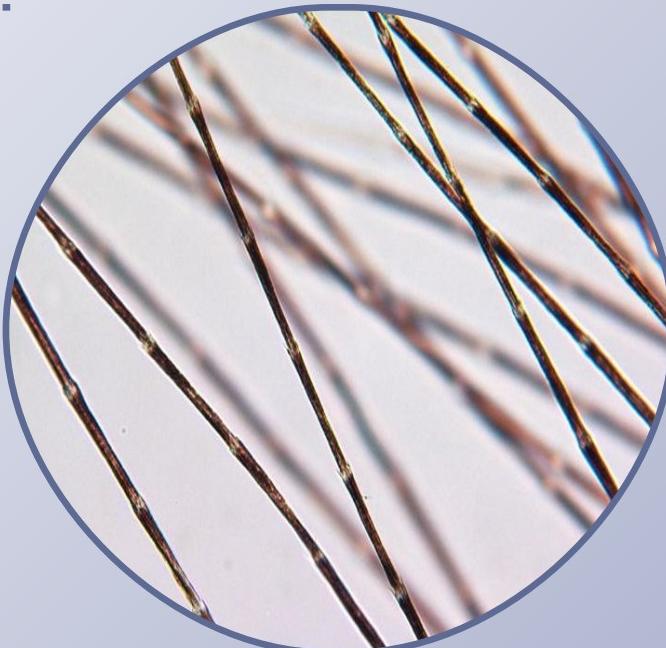
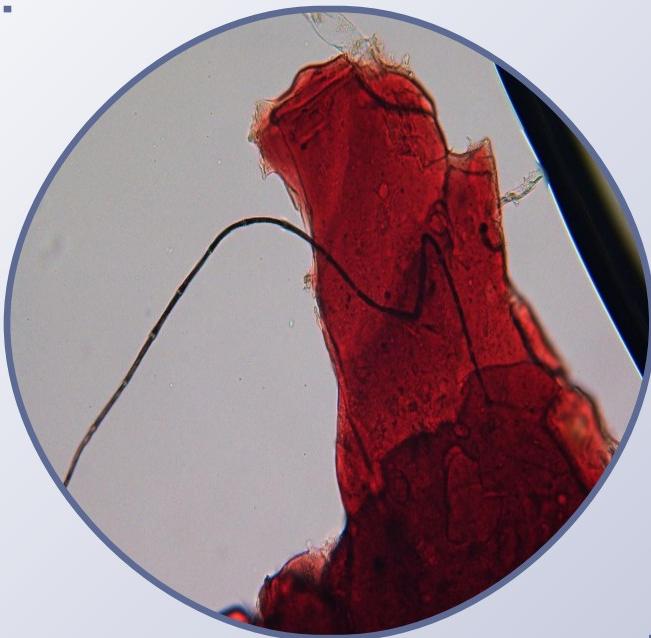
Altitude = 1,500'

Impact point: wing





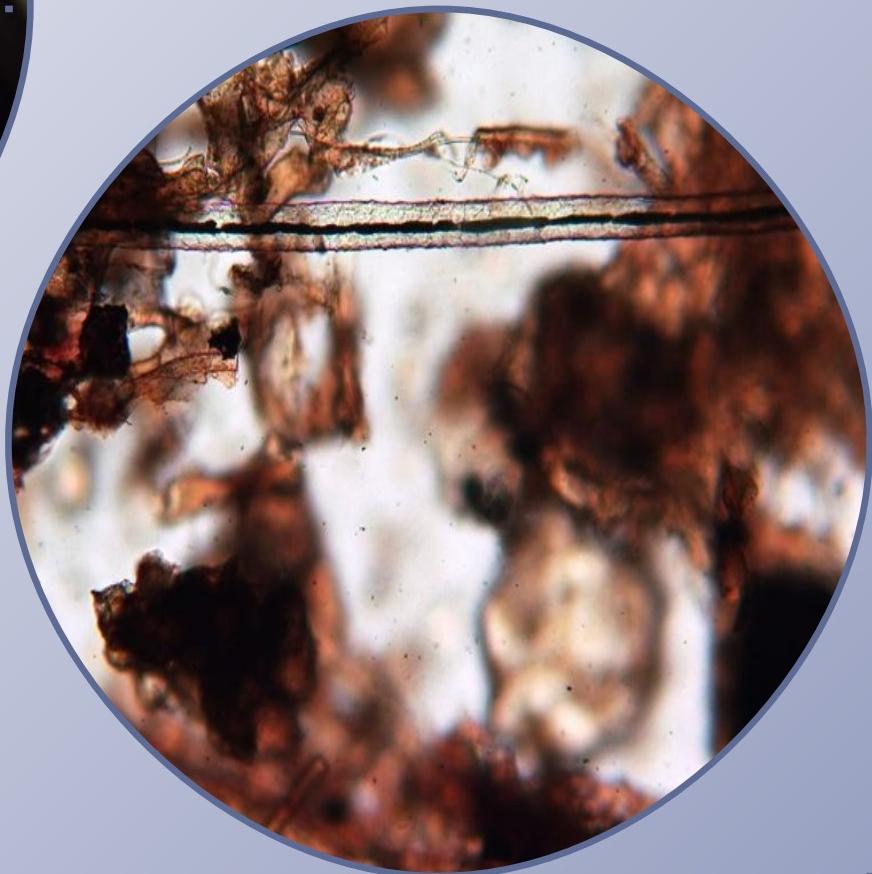
Microslide of unknown  
sample





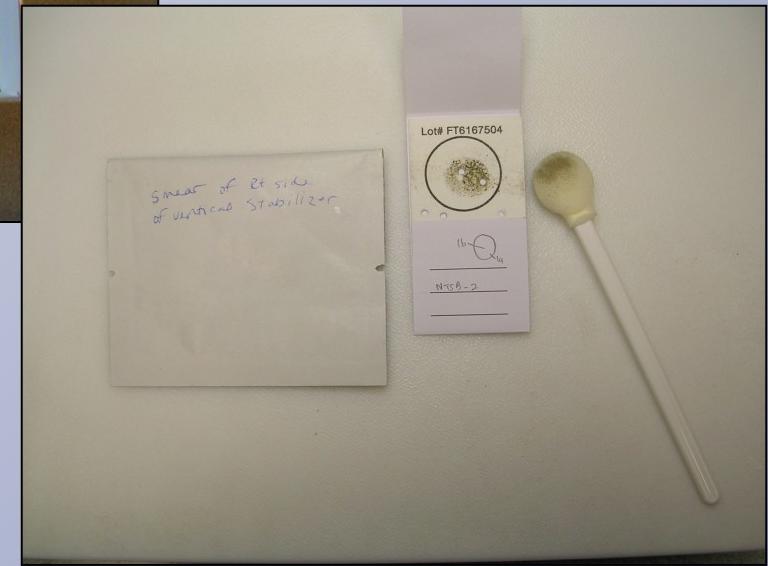


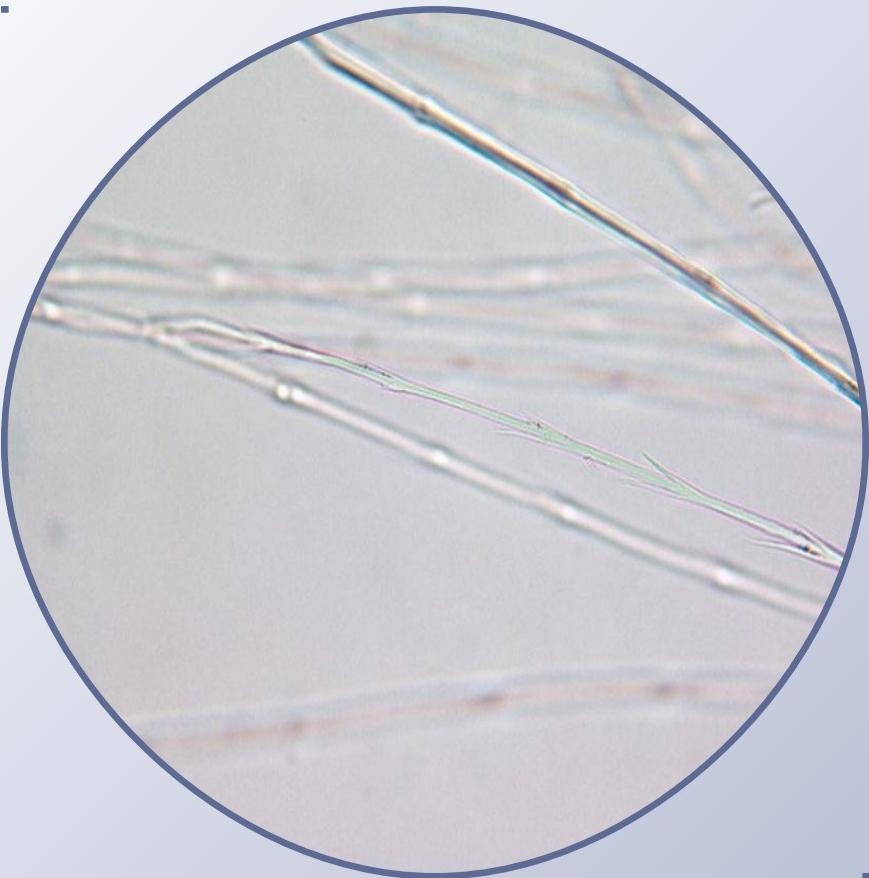




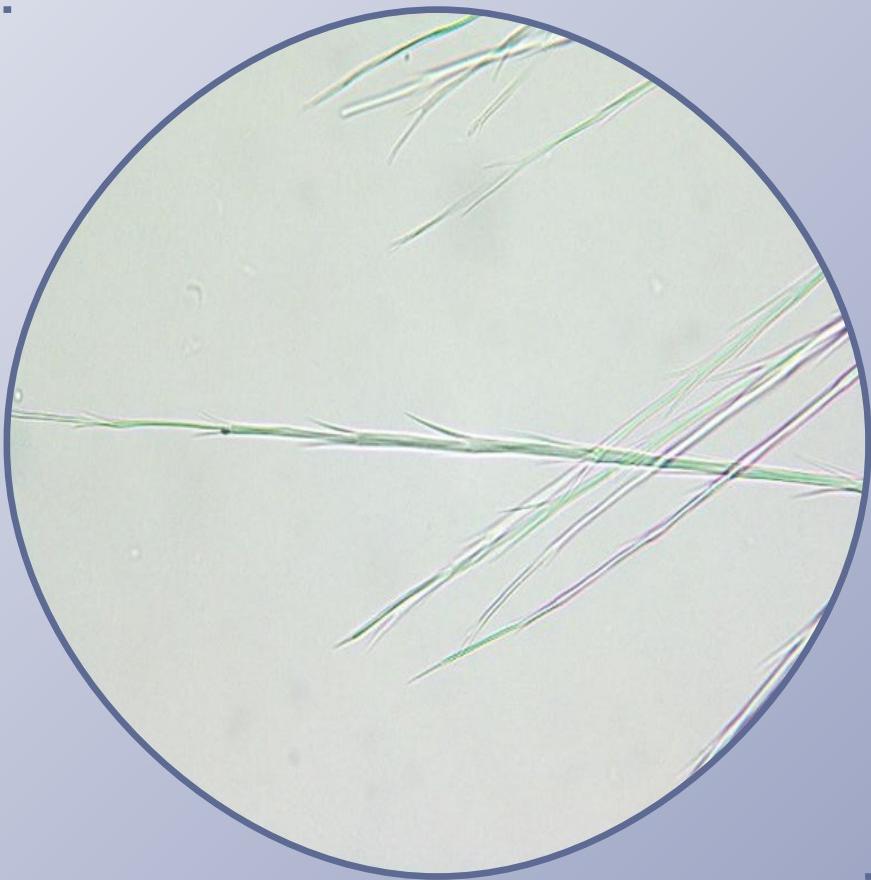


Delta Report		BIRD/OTHER WILDLIFE STRIKE REPORT Confidential No. 2005-53-00051 Facilities Reported	
<p>Location: <u>Atlanta, GA</u></p> <p>Date: <u>10/10/05</u></p> <p>Aircraft: <u>ATLANTA AIRPORT</u></p> <p>Comments: <u>None</u></p> <p><i>(Handwritten notes: "Contact - Michael Gail" and "→ 17-B")</i></p>		<p>Page 1 of 1</p> <p><b>BIRD/OTHER WILDLIFE STRIKE REPORT</b> Report Form For Reporting Incidents Involving Airspace Intrusions and Wildlife Strike Events</p> <p><b>RODOSYSTEM</b> Reporting &amp; Analysis Species Identification Resource</p> <p><i>(A graph titled "Estimated Number of Birds vs. Altitude" showing data from 1000ft to 10000ft)</i></p>	
<p><b>1. Aircraft Information</b></p> <p>Name of Operator: <u>Coca Cola</u></p> <p>Aircraft Model: <u>ATLANTA AIRPORT</u></p> <p>Complaints: <u>1</u></p> <p>Engine Manufacturer: <u>GE</u></p> <p>2. Aircraft Registration</p> <p>Registration: <u>N111CA</u></p> <p>3. Date of Flight</p> <p>Date: <u>10/10/05</u></p> <p>Time: <u>10:00 AM</u></p> <p>Local Time: <u>10:00 AM</u></p> <p>4. Flight Number</p> <p>Flight Number: <u>1</u></p> <p>5. Wildlife/Birds Encountered</p> <p>Species: <u>None</u></p> <p>6. Airspace Entered</p> <p>Airspace Entered: <u>Runway End</u></p> <p>7. Height Above Sea Level</p> <p>Height: <u>0 ft</u></p> <p>Speed: <u>100 mph</u></p> <p>8. Position of Aircraft</p> <p>Position: <u>Runway End</u></p> <p>9. Position of Bird</p> <p>Position: <u>Runway End</u></p> <p>10. Type of Flight</p> <p>Type: <u>Normal</u></p> <p>11. Status of Runway</p> <p>Status: <u>Clear</u></p> <p>12. Weather Conditions</p> <p>Weather: <u>Cloudy</u></p> <p>13. Bird Species</p> <p>Species: <u>None</u></p> <p>14. Effect on Flight</p> <p>Effect: <u>None</u></p> <p>15. Airspace Condition</p> <p>Condition: <u>Normal</u></p> <p>16. Alerted Total (Pilot, Controller, Landing Gear Shutter, Other (Specify))</p> <p>Total: <u>0</u></p> <p>17. Bird/Other Wildlife Species</p> <p>Species: <u>None</u></p> <p>18. Number Seen</p> <p>Count: <u>1</u></p>			





Unknown sample



Reference sample

Smear of Rt side  
of vertical stabilizer

Lot# FT6167504

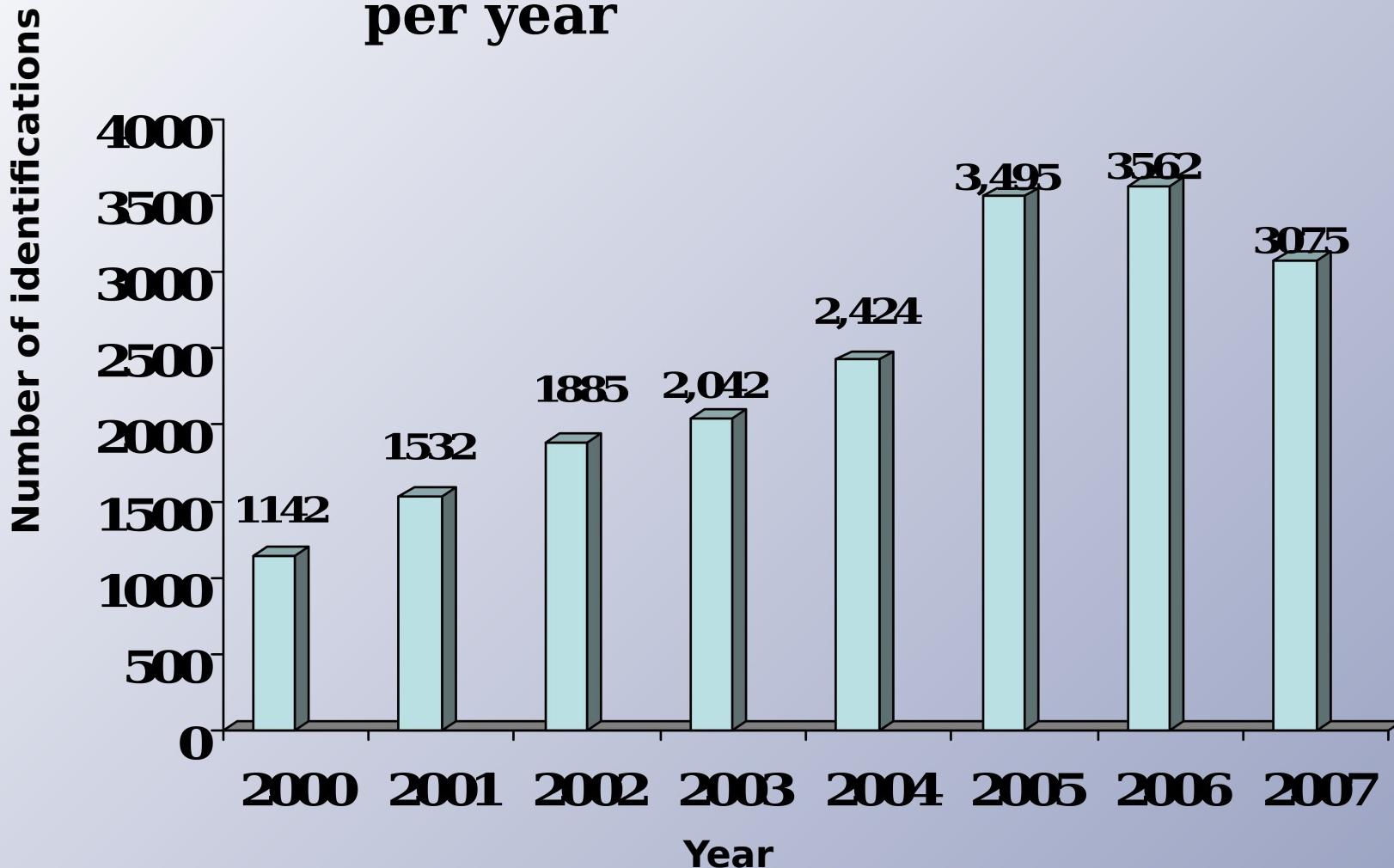


1b-Q<sub>1a</sub>

NTSB-2



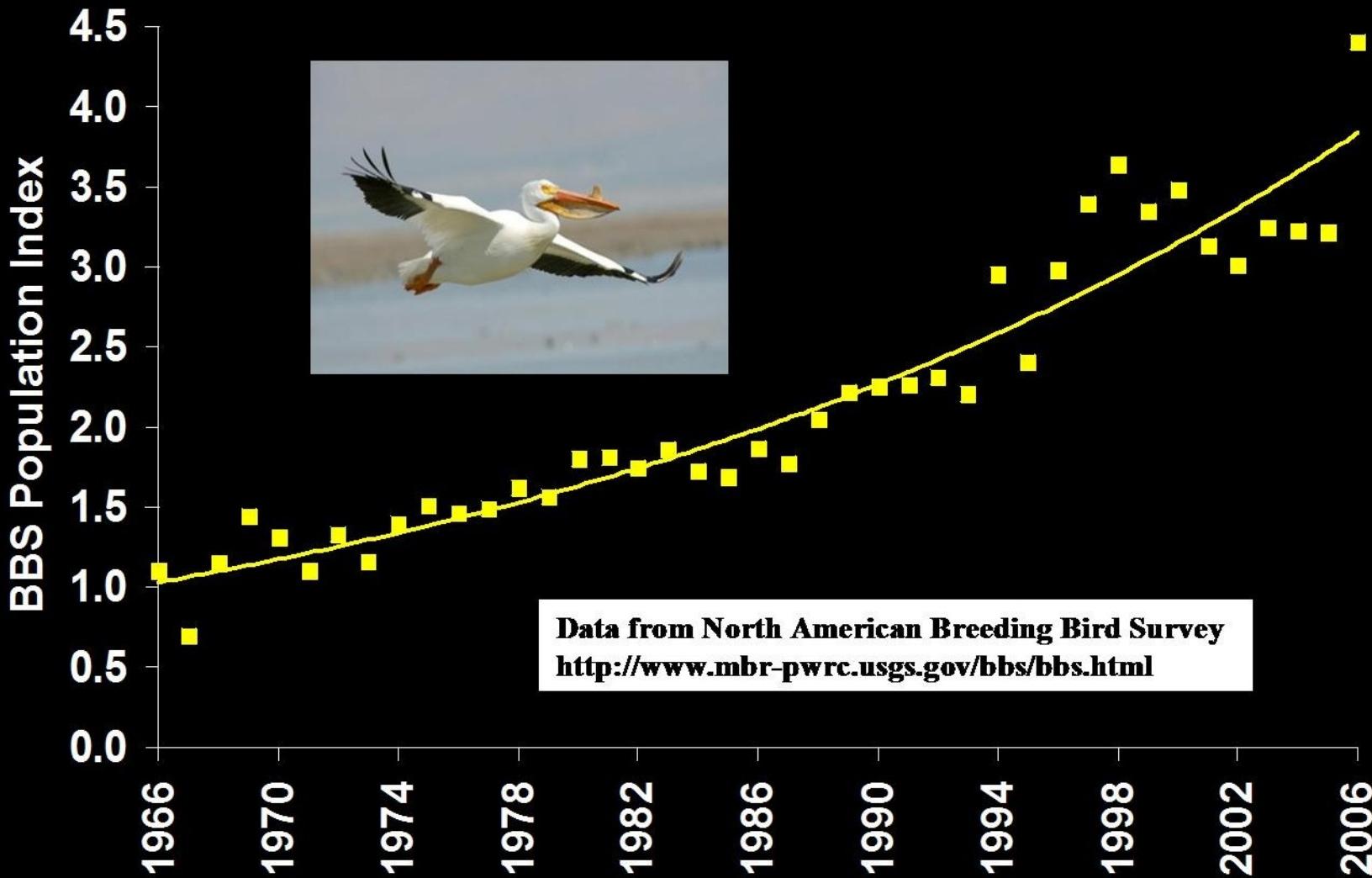
# **Number of USAF Identifications per year**



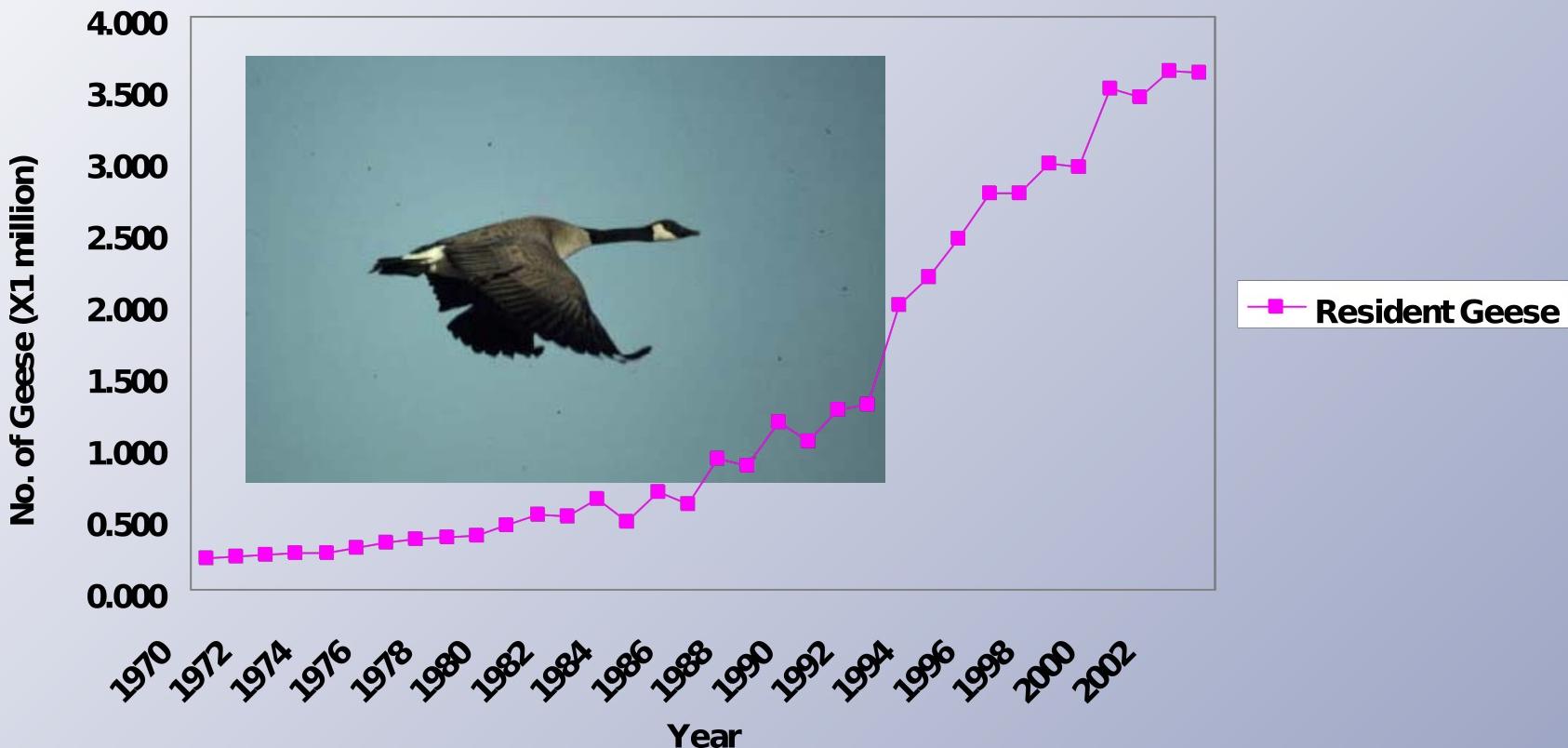
- 36 species of birds in North America exceed the 4 pound FAA weight standard established for airworthiness of airframes and windshields
- 13 of the 14 bird species in North America with mean body masses greater than 8 pounds have shown significant population increases over the past three decades



# Breeding population of white pelicans has increased at a mean annual rate of 4.3% in North America, 1966-2006



# **RESIDENT (NON-MIGRATORY) CANADA GOOSE POPULATION IN NORTH AMERICA INCREASED FROM 1 MILLION IN 1990 TO 3.6 MILLION IN 2003**



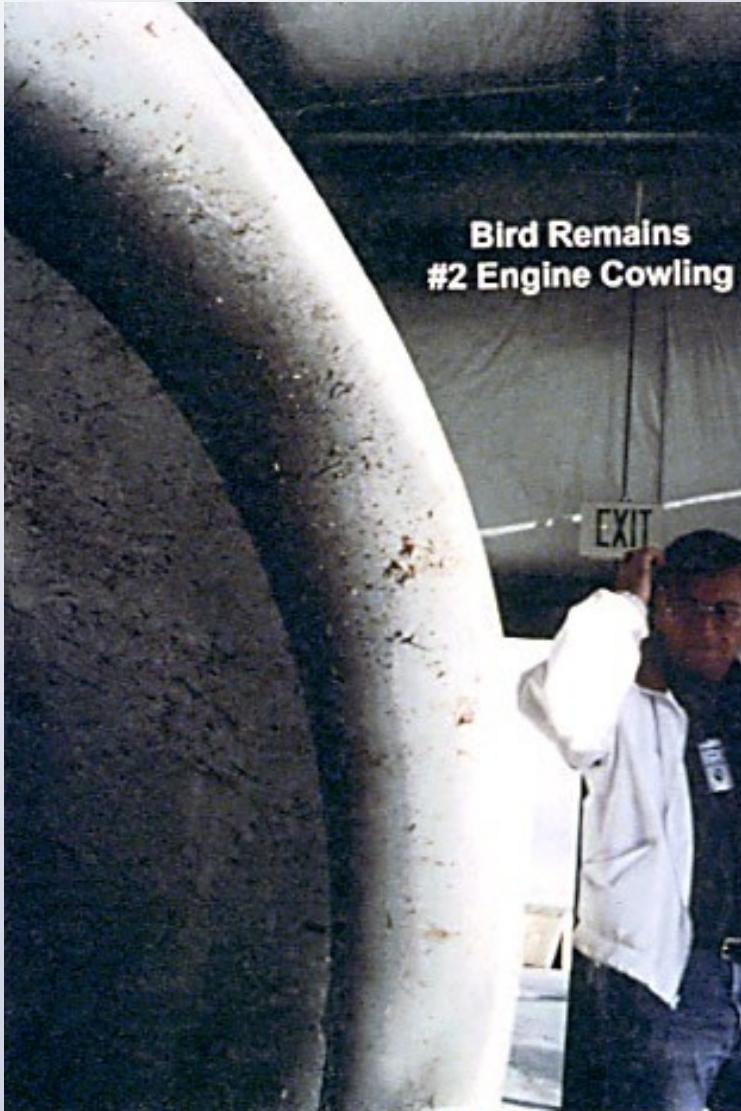
**(Source U.S. Fish and Wildlife Service)**



Elmendorf Air Force Base, Alaska  
22 Sept 1995



## USAF Canada Goose Strikes



	Count	Benchmarks
<b>1993</b>	12	
<b>1994</b>	7	
<b>1995</b>	5	24 strikes
<b>1996</b>	2	
<b>1997</b>	0	
<b>1998</b>	6	8 strikes
<b>1999</b>	4	
<b>2000</b>	5	
<b>2001</b>	6	
<b>2002</b>	2	
<b>2003</b>	1	
<b>2004</b>	2	
<b>2005</b>	2	
<b>2006</b>	3	33 strikes 1996-2006



### Feather Lab Support:

- U.S. Air Force, HQ AFSC  
Bird Aircraft Strike Hazard  
Program

- U.S. Department of  
Transportation - Federal  
Aviation Administration-  
William J. Hughes Technical  
Center

- U.S. Air National Guard -  
Environmental Planning  
Branch

- U.S. Department of  
Defense (DoD) Legacy  
Resource  
Management Program

- Smithsonian Institution -  
LAB



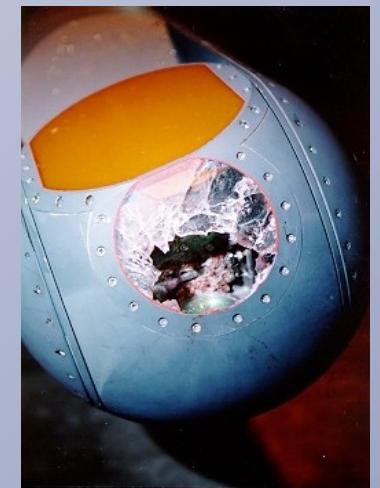
- Special thanks to Capt. Laura Stepko, USAF Safety Center  
for assistance with statistical data for this presentation.*

# Benefits of species identification data:

Development of protection against aircraft

windshields and engines based on weights of birds

- USAF F-16 cockpit redesigned to lower pilot's seat in position to avoid injury from break-away debris
- Data used for USAF BAM (Bird Avoidance Model)
- Data used to justify construction of landfills away from airfields
- Habitat management plans implemented to discourage bird use on airfields
- Pest Management/bird control on airfields
- USFWS depredation permits
- Information on migration, habitat preference, diet, life history





# Questions

dovec@si.edu  
202-633-0787



Image courtesy USAF - Flying Safety Magazine